NASA TECH BRIEF

Computer Programs Simplify Optical System Analysis

The problem: Modern optical systems frequently require the use of nonspherical reflecting and refracting elements (ellipsoids, paraboloids, hyperboloids, cones, cylinders). Design of these optical systems requires many complex time-consuming computations.

The solution: Computer programs which perform geometrical ray tracing and calculate energy distributions in optical systems containing nonspherical as well as spherical elements.

How it's done: Two digital computer programs have been formulated to aid in the design of complex optical systems. One program traces the path of a light ray through the optical system. The other calculates the energy output incident on specified target areas.

The optical ray-trace program calculates the path of a ray for which the initial coordinates and direction have been specified. This program is sufficiently general to cover arbitrary orientation of any of the elements for rays undergoing reflection or refraction at any portion of the optical surface. The output from the ray-trace program is the location and direction of the ray at the last optical surface in the system and the total optical path length of the ray.

The energy-trace program calculates the relative monochromatic flux density on a specified target area receiving radiation from a finite incoherent source. The program tabulates the flux densities and plots a monochromatic brightness distribution of the source as seen from the target area. The energy-trace program uses the optical ray-trace program as a subroutine to generate a representation of the optical system.

Notes:

1. The ray-tracing program can also be applied to optical elements that are not generated by revolution of a conic section.
2. Optical systems incorporating diffraction gratings may be analyzed without making major modifications in the logical structure of the computer program.
3. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B65-10093

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

Source: Honeywell, Inc.
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